

Nascom Microcomputers

hardware manual

IMP

impact matrix printer
for microcomputer
systems

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1. INTRODUCTION

This manual instructs the user of the IMP printer in its setting up and operation. Information on maintenance and rectification of running problems is also provided.

It is essential that this manual be read in its entirety before the printer is commissioned.

It is strongly recommended that this manual be read in conjunction with the manual(s) for the computer system with which the printer is to be operated; particular attention should be paid to the correct connection of the serial data link and to the programming of the serial I/O devices of the host system.

2. CAUTIONS

Caution: the printer mechanism operates at high speed and may trap loose objects or fingers. No attempt at adjustment should be made while the printer is operating and care should be taken while examining the operation of the printer to avoid hair or loose jewellery being ingested by the mechanism.

Caution: the power supply unit is capable of maintaining 40V on the circuit board for a considerable time after the machine is switched off. This voltage is dangerous and may administer a harmful shock. If it is essential that the printer be serviced immediately after use, the main smoothing capacitor supported above the circuit board should be short-circuited with a 330R resistor. This method should not be used unless it is necessary as it will shorten the capacitor's life.

Caution: under no circumstances should the print head be touched while the printer is active; it becomes warm during operation, and any arrest of its motion may cause its motors to stall and overheat, resulting in damage.

3. SETTING UP

3.1 Mains connection

THE INSTRUCTIONS GIVEN IN THIS SECTION MUST BE FOLLOWED EXACTLY IF OPERATION OF THE PRINTER IS TO BE SAFE. UNDER NO CIRCUMSTANCES MAY THE PRINTER BE OPERATED WITHOUT AN EARTH CONNECTION; SUCH OPERATION COULD PRODUCE A SERIOUS SAFETY HAZARD.

The printer is supplied without a mains plug; the user may select the type of plug most suitable for the application. Any plug used must conform to British Standard. For domestic use in the U.K. the printer must be fitted with a 13A plug to British Standard 1363 fitted with a 2A fuse. For industrial use in connection with filter equipment the use of IEC connectors is permissible provided that the circuit is individually fused 2A or routed through a circuit breaker set at 2A.

13A plugs should be wired as follows:

GREEN/YELLOW	EARTH (top connection)
BROWN	LIVE (fused connection)
BLUE	NEUTRAL

Most plugs are supplied with a diagram showing the exact wiring method for that particular plug; if in any doubt at all consult a qualified electrician or the shop that sold the plug.

3.2 Paper selection

Two types of paper may be used; plain paper, either in sheets or rolls, with a maximum width of 8½ inches, or 'pinfeed' paper, whose edges are punched to engage with the tractor drive units, which may be bought in rolls or 'fanfold', which is a continuously folded stack of separable sheets. The maximum width of pinfeed paper is 9½ inches, of which 1 inch is occupied by the punched edges.

Most types of paper may be printed upon; the ideal is the thin, hard paper of the type used by line printers, though telex machine rolls are quite acceptable and may be supported by the printer. Letterheaded sheets may also be printed upon, though there is no means of feeding them automatically. It is recommended that the paper used should not exceed 0.013" (0.33mm); paper is more commonly specified by its density, which should not exceed 120 grams per square metre.

If the printer is required to support rolls of paper the two brackets supplied should be attached to the rear panel to support the paper roll spindle; the flanges by which the brackets are mounted face outwards from the roll area.

3.3 Paper setting

The printer may feed itself with paper either by tractor tension on the edges of pinfeed paper or by roller pressure on plain paper. The two should not be used simultaneously; if pressure feed is selected while pinfeed paper is in use the tractors will probably tear the paper.

Tractor/pressure selection is made by the two small levers located immediately behind the paper path on each side of the spring clip retaining the ribbon cartridge; the right-hand lever is provided with a locking device. The levers lift the pressure roller away from its drive bar; therefore, if pressure feed is NOT required the two levers should be pulled forwards and the locking device moved to the right to engage the right-hand lever. To return to pressure feed simply unlock this lever; the pressure roller will spring back audibly.

The two tractor units may be moved along their rails by locating the small lever that pivots on the uppermost rail, on the outside of each unit, and pulling it forwards and up through about 45 degrees; the tractor will then be unlocked and may slide along the rails. To lock the tractor return the lever to its original position.

When plain paper is in use the tractors should be set so that they do not interfere with the paper's motion. To load pinfeed paper the two ears on the inside of each tractor unit should be lifted to expose the tractor belts; the tractor units should then be moved so that the holes in the paper align as exactly as possible with the pins on the tractor belts; no horizontal force should exist as the paper will tear when fed unless it runs easily. The tractors should then be locked and the paper loaded.

3.4 Paper loading

Rolls of plain paper may be supported on the spindle provided, which rests in the brackets bolted to the rear of the printer. Unroll about 18" of paper and place the roll behind the printer. Lock up the pressure feed levers as if setting up for tractor feed. Push the paper gently into the large aperture at the rear of the printer; it will appear behind the transparent panel immediately below the print head. Continue to push and it will emerge from the mechanism. Pull about a foot through, make sure that the tractors are clear of the paper and that the paper is free to move. Put the spindle through the roll core and hang it on the brackets. Hold the roll and pull its end; this will ensure that no kinks are present. Unlock the pressure roller. The printer is now loaded.

Pinfeed paper must be fed through the aperture in the base of the printer. Having set the tractor spacing, proceed as for plain paper until the paper emerges from the mechanism. Lift the ears of the tractors and engage the paper on the tractor belts. Lower the ears. It is not possible to run the paper through to align it but any error will make itself obvious within seconds of commencing operation. If this occurs, switch off and reload or adjust as necessary.

3.5 Preferred operating conditions

- 1 Temperature: 10C to 25C
- 2 Humidity: 5% to 80% (non-condensing)
- 3 Support: adequate and level support should be provided for all four feet, if necessary with an aperture to allow fanfold paper to be fed from below the machine. Purpose-built printer tables with such an aperture are commercially available. The use of rollfeed paper does not require the provision of such a facility. Operation of the printer on a hollow and resonant surface may double its noise output.
- 4 Precaution: nothing should be placed on top of the printer or in any position that would obstruct the paper path away from it. Care should be taken to ensure that paper is not allowed to re-enter the rollfeed aperture and become caught in the feed rollers; damage could result from this occurrence.

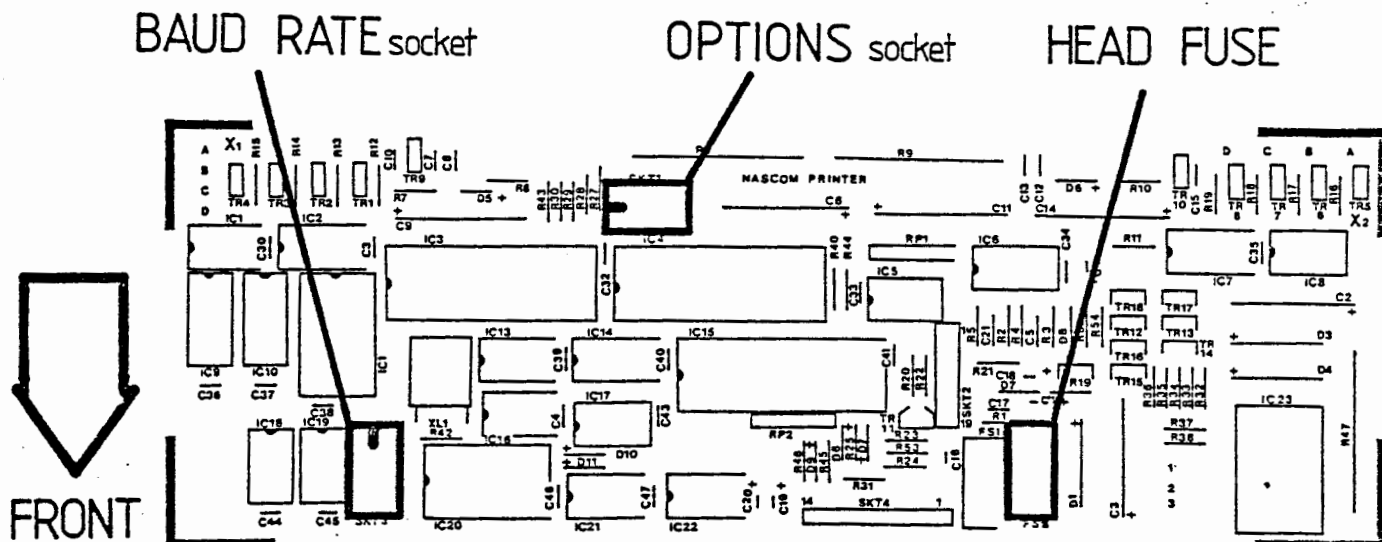
3.6 Standard settings

The printer is set during manufacture as follows; it should be confirmed that these settings are acceptable to the host system before operation proceeds.

data transmission rate	300 baud
automatic linefeed	off
stop bits	two
parity	disabled (even)
word length	8 bits

If any of these parameters requires change, please refer to section 4.

IMP P.C.B.:user serviceable parts



4.1 Baud rate selection

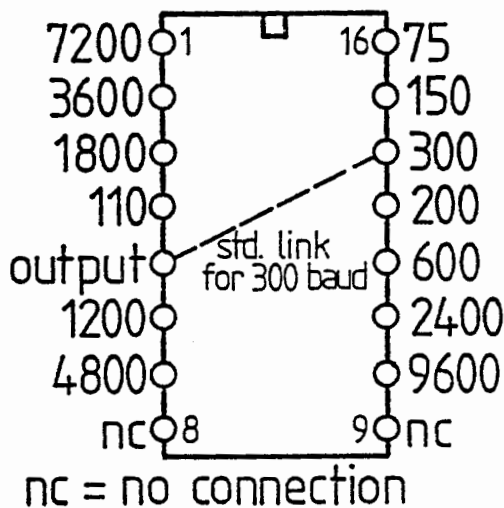
The data transmission rate at which the printer accepts instruction is measured in bits per second (baud); this is normally set at 300. Other rates are available and may be selected by the insertion of a suitable wired 16 pin header plug into the socket SKT3.

N.B.:— BEFORE ANY ATTEMPT IS MADE AT MODIFICATION OF THIS OR OTHER SETTINGS THE SECTION OF THIS MANUAL DEALING WITH MAINTENANCE SHOULD BE READ.

The socket is fed with all available baud rates and puts out one only to the control circuitry. This output is taken from pin 5; selection is therefore made by wiring one (only) of the other pins to pin 5. Rates available on the socket are as follows; it should be noted that each rate will require its own selection plug as it is not possible to wire a plug to select more than one rate:

pin	baud rate	pin	baud rate
1	7200	9	none
2	3600	10	9600
3	1800	11	2400
4	110	12	600
5	(output)	13	200
6	1200	14	300 (wired as std.)
7	4800	15	150
8	none	16	75

Note: header plugs are best inserted into a separate socket before wiring as this ensures that the pins do not lose their alignment as a result of the soldering temperature. It is not recommended that any form of switch be fitted to the plug.

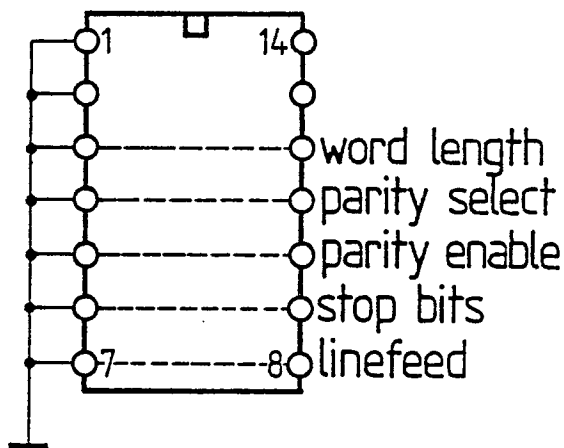


4.2 Control option selection

The printer may be set up to conform to most common data transmission protocols by the insertion of a suitably wired plug into socket SKT1, having first switched off the printer and taken the appropriate precautions to avoid electric shock.

The plug has 14 pins, 7 of which are connected to ground (0V). The connection or otherwise of the remaining 7 pins effects all possible selections; it is therefore possible simply to wire across the plug to select a particular option. Available options are:

pins connected	result of connection	result of non-connection
7-8	a line feed will be performed for each carriage return, and each linefeed character input	linefeed will be performed only on receipt of a linefeed command
6-9	a single stop bit is set	two stop bits are set
5-10	parity is enabled	parity is disabled
4-11	parity set as odd	parity set as even
3-12	word length set as 7 bits	word length set as 8 bits
2-13	none	none
1-14	none	none



5 OPERATION

5.1 Control panel

The printer control panel is fitted with four controls and three indicators. The indicators are mounted in the control buttons, but are not in all cases related to the button in which they are mounted.

The top left-hand control is the power switch; pressing its lower half will switch the printer on.

The top right-hand control is the line feed button, which contains the power indicator. When lit yellow this indicates printer activity. The button will cause a single line feed every time it is pressed unless it is held down for more than 640mS (just over half a second); if held, it will cause a continuous paper feed that will stop at the next line that becomes available after it is released.

The bottom left-hand control is the online button, containing the online indicator. When pressed, this button will lock down until pressed again. When the button has been pressed the printer is connected to the host system and may receive data. This condition is indicated by the illumination of the button in green. When the printer is offline its host system will be informed by the setting of the BUSY output signal, which, if the host system is able to accept it, will cause data transmission to cease.

The bottom right-hand control is the reset button, containing the error indicator. Should an error in data transmission occur, it will be detected and will cause the

print buffer to be loaded with a 'rubout' character (//). The error indicator will simultaneously be illuminated in red to inform the operator that such an error has occurred, the // mark on the paper enabling the exact location of the error to be determined. The ERROR light will also indicate a buffer overflow; in this condition incoming characters will be ignored until buffer space becomes available. The error indicator may be cancelled only by operation of the reset button, which will also erase the contents of the data buffer. The reset button should therefore not be operated until the printer has emptied its buffer and is at rest. It may, however, be used to curtail the printing of unwanted material.

Note that the operation of the linefeed button is not restricted to times at which the printer is at rest; it may be pressed during the printing of a line, whereupon it will be recognised at the end of the line and the next line will be printed after a line feed has been performed. If held during printing it will cause the machine to complete its line then feed paper until the button is released, whereupon it will resume printing on the next available line.

5.2 Automatic selection of unidirectional operation

As a safety feature the printer will, if called upon to print lines containing more than 40 characters (not including spaces), commence printing in one direction only until such requirement ceases to be made, whereupon bidirectional printing will immediately be resumed.

6 MAINTENANCE

WARNING: BEFORE REMOVING THE PRINTER'S COVER THE MAINS PLUG MUST BE DISCONNECTED FROM ITS SOCKET. NO ADJUSTMENT OR MODIFICATION MUST BE MADE TO AN ACTIVE MACHINE.

6.1 Access to internal components

A 3/32" Allen Hexagon key will be required. Release the four bolts holding the ABS cover to the chassis. With a small standard screwdriver remove the single screw retaining the small metal housing over the base of each tractor rail mount, allowing the housings to be removed. Release the left-hand side of the cover first by gently lifting it by about an inch to clear the mechanism, then move it to the right to release the right-hand side. Swing the right-hand side of the cover so that the cover rests upside down to the left of the chassis. The cables connecting the control panel to the chassis should be observed to ensure that they are not under tension. Keep all housings, screws and other parts removed in a safe place. If a screw is lost do not replace it with a larger one.

6.2 Fuse replacement

The printer is fitted with a mains fuse which is located on the rear panel immediately above the mains cable entry point. The fuse holder unscrews to permit replacement of the fuse, which is a 750 milliamp 20mm type. Repeated and frequent failure of this fuse is normally indicative of the existence of an electrical or electronic fault.

A fuse has also been fitted in the circuit operating the print head. In the case of head overload this fuse will rupture. It is located on the circuit board to the right of the print head plug; it is marked FS2 (see fig. 1). In the unlikely event of this fuse's failure replace it with a 3 amp 20mm antisurge type. Repeated and frequent failure of this fuse will indicate a fault in the head or its driver devices and should be reported to Nascom Microcomputers Ltd.

6.3 Ribbon replacement

Ribbon replacement does not require the removal of the cover, though the printer must be switched off. Remove the paper. Unlock the tractors and move them to the ends of their rails. If the printer is being fed from a roll, remove the roll and its spindle.

At the centre of the ribbon cartridge, between the two pressure roller levers, there is a spring clip retaining the ribbon cartridge. Pull the clip forwards and lift the cartridge up and backwards, noting the position of the channel in which the ribbon runs. Wind loose ribbon into the cartridge by turning the small white knob anti-clockwise. Fit a new cartridge by allowing the ribbon into its channel and turning the white knob until the cartridge drops into place against the force of the spring clip. Press the

clip into position, lifting it slightly if necessary; (1). Wind the white knob until the ribbon is under normal tension. If the ribbon will not move, or the cartridge fails to assume the correct position, remove the cartridge and start again. Like most things designed to be easy it is - after the first attempt. Do not attempt to refill a used cartridge and do not retain old cartridges. Under no circumstances attempt to load the printer with anything except the Two-Day Corporation ribbon cartridges available from Nascom Microcomputers distributors; typewriter cartridges or ribbons will NOT do.

- (1) Note that the right-hand side of the cartridge is slightly higher than the left-hand side; this is to ensure that the print head traverses the ribbon at an angle, maximising its usage.

6.4 Lubrication

It is unlikely that the printer will require replacement of its lubricant; however juddering or stalling of the print head normally indicates such requirement. The formation of condensation on the mechanism may aggravate this condition.

Two types of lubricant are needed; IBM GREASE NO. 22 or its equivalent, which may be purchased from typewriter shops and those dealing with IBM office equipment generally; and Singer sewing machine oil, which is normally kept by sewing machine shops.

Grease should be applied very sparingly to the gear trains and their bearings. Care should be taken to avoid contaminating the nylon drive belts with the grease and to avoid unnecessary skin contact as the grease may cause irritation.

Oil should be applied sparingly to the print head rail (the polished cylindrical rod on which the print head runs) and to no other part. The frame edge immediately in front of the helical cam, on which the print head is supported, may be lightly greased if necessary.

6.5 Limit switch adjustment

Serious misalignment of consecutive lines may be due to the limit switches, which are located at each end of the helical cam driving the print head. Each is secured with two screws. The right-hand switch should be adjusted first. The purpose of the adjustment is to ensure that the switch signals the circuitry at the moment at which the head starts one traverse. Switches should never be moved by more than a millimetre at a time; smaller adjustments are normally sufficient. After each adjustment ensure that the lever actuator on top of the switch just touches the chassis above it and is unobstructed. Test the printer after each adjustment and switch off IMMEDIATELY if the machine cannot print normally. The limit switches are set during manufacture and it is most unlikely that any adjustment will become necessary except as the result of pronounced wear of the helical cam.

Appendix 7.2

NASPRINT operating system listing

IEAP 1.2 Z80 Assembler - Source Listing

```

0030 ; *****
0040 ; * NAS-PRINT 2 *
0050 ; *****

0000 ; (C) Copyright 1979
0090 ; Nascom Microcomputers Ltd.

0000 0110 ORG 0

0150 ; PORT ADDRESSES
0160 ; *****

0000 0030 0180 PAD EQU #30 ;PIO A DATA
0000 0032 0190 PAC EQU #32 ; CONTROL
0000 0031 0200 PBD EQU #31 ; B DATA
0000 0033 0210 PBC EQU #33 ; CONTROL
0000 0018 0220 ;
0000 0018 0230 UDAT EQU #18 ;UART DATA
0000 0020 0240 USTAT EQU #20 ; STATUS

0270 ; MEMORY EQU's
0280 ; *****

0000 2800 0300 RAM EQU #2800 ;RAM START
0000 0400 0310 RAMLEN EQU #400 ;RAM LENGTH
0000 2C00 0320 STACK EQU RAM+RAMLEN ;SP
0000 0000 0330 ;
0000 0000 0340 ROM EQU #0 ;ROM START

0370 ; PIO CONTROL BIT NOS.
0380 ; *****

0000 0000 0400 AUTOLF EQU 0 ;AUTO LF SWITCH
0000 0001 0410 RHS EQU 1 ;RHS MICROSWITCH
0000 0002 0420 LHS EQU 2 ;LHS -- " --
0000 0003 0430 LFSW EQU 3 ;LINE FEED SWITCH
0000 0004 0440 ONLINE EQU 4 ;ONLINE SWITCH
0000 0005 0450 LFSTEP EQU 5 ;LINE FEED STEPPER
0000 0006 0460 BUSY EQU 6 ;BUSY LINE
0000 0007 0470 RSLED EQU 7 ;RESET LED
0000 001F 0480 MASK EQU #1F ;I/O MASK FOR PORT 'A'
0000 0007 0490 ;
0000 0007 0500 HMOTOR EQU 7 ;HEAD MOTOR (PORT B)

0530 ; CONSTANTS
0540 ; *****

0000 000A 0560 LF EQU #0A ;ASCII LF
0000 000D 0570 CR EQU #0D ; CR
0000 0008 0580 BS EQU #08 ; BS
0000 0060 0590 ULF EQU #60 ;'UART' LF
0000 0061 0600 UCR EQU #61 ; CR
0000 00FF 0610 RAMMRK EQU #FF ;PHYSICAL BUFFER END
0000 00FE 0620 EMPTY EQU #FE ;'NO CHAR' IN BUUF
0000 000A 0630 SPARE EQU 10 ;BUSY WARNING LENGTH
0000 0040 0640 STACKL EQU #40 ;STACK LENGTH
0000 0018 0650 STEPS EQU 24 ;STEPS PER LINE FEED
0000 001C 0660 UFMASK EQU #1C ;FOR UART STAT FLAGS
0000 05F0 0670 NMITOT EQU 1520 ;NMI/LINE (14+5)*80
0000 0005 0680 INTCHR EQU 5 ;NMI/INT.CHAR.CAP
0000 0020 0690 CHLINE EQU 40 ;PNTD. CHAR/LIN

0720 ; 'FLAG' BIT NOS
0730 ; *****

0000 0000 0750 LTOR EQU 0 ;LEFT TO RIGHT PRINT
0000 0001 0760 NM EQU 1 ;OFFNMI DONE
0000 0002 0770 POLL EQU 2 ;DO POLL IF SET

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0800 ;          RAM WORKSPACE
0810 ;          *****

2800          0830      ORG    RAM
2800 0001          0840 JUMP   DEFS 1      ;FOR 'EC3' $NMI 'JP'
2801 0002          0850 $NMI  DEFS 2      ;NMI REFLECTION
2803 0002          0860 LNSTRT DEFS 2      ;START OF PRINT LN
2805 0001          0870 NCOUNT DEFS 1     ;NMI COUNTER
2806 0001          0880 FLAG   DEFS 1     ;FLAG BYTE
2807 0002          0890 COUNTS DEFS 2     ;CHAR COUNTERS
2809 2809          0900 INIT   EQU  $     ;START CLEARED RAM
2809 0001          0910 HEDBUF DEFS 1     ;DATA FOR PRNT HEAD
280A 0002          0920 WTCNT  DEFS 2     ;WAIT TO COUNT
280C 280C          0930 INITE  EQU  $     ;END CLEARED RAM
280C 0001          0940 UBOT   DEFS 1     ;BOT OF UBUF
280D 280D          0950 UBUF   EQU  $     ;START OF UART BUFFER
280D 03B2          0960 FREE   EQU  STACK-STACKL-UBUF-1
280D 28BE          0970 UBUFT  EQU  STACK-STACKL-2;TOP OF UBUF

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```

1010 ;          ROM PROGRAM
1020 ;          *****

0000          1040      ORG    ROM
0000 31002C      1050 RESET   LD    SP,STACK
0003 3EC3        1060          LD    A,$C3      ;INSERT $NMI 'JP'
0005 320028      1070          LD    (JUMP),A
0008 212B02      1080          LD    HL,IGNNMI  ;SET $NMI TO IGNORE
000B 220128      1090          LD    ($NMI),HL
000E D0210628    1100          LD    IX,FLAG
0012 D0CB0096    1110          RES    POLL,(IX+0);NO POLLING
0016 3E0F        1120          LD    A,$0F      ;OUTPUT MODE
0018 D333        1130          OUT   (PBC),A    ; FOR PORT 'B'
001A 3ECF        1140          LD    A,$CF      ;CONTROL MODE
001C D332        1150          OUT   (PAC),A    ; FOR PORT 'A'
001E 3E1F        1160          LD    A,MASK     ;I/O MASK
0020 D332        1170          OUT   (PAC),A    ; FOR PORT 'A'
0022 3E80        1180 ;
0022 3E80        1190          LD    A,$80      ;MOTOR OFF
0024 D331        1200          OUT   (PBD),A
0026 D830        1210          IN     A,(PAD)
0028 CB57        1220          BIT    LHS,A     ;AT LHS ?
002A 280D        1230          JR     Z,LOFF    ;YES - SKIP
002C CD8503      1240          CALL   MOTON
002F CDC202      1250 SETHED CALL   DEBUNC
0032 CB57        1260          BIT    LHS,A     ;AT LHS ?
0034 20F9        1270          JR     NZ,SETHED ;NO - WAIT
0036 CD4803      1280          CALL   MOTOFF    ;YES - TURN MOTOR OFF
0039 AF          1290 LOFF    XOR    A         ;SWITCH OFF LED
003A CBFF        1300          SET    RSLED,A
003C D330        1310          OUT   (PAD),A
003E 210928      1320          LD     HL,INIT   ;INITIALISE RAM
0041 0603        1330          LD     B,INITE-INIT
0043 3600        1340 SET1    LD     (HL),0
0045 23          1350          INC    HL
0046 10FB        1360          DJNZ   SET1
0048 36FF        1370          LD     (HL),RAMMRK;HL=UBOT
004A 23          1380          INC    HL       ;HL=UBUF
004B 36FE        1390          LD     (HL),EMPTY ;MARK UBUF AS EMPTY
004D 110E28      1400          LD     DE,UBUF+1
0050 01B203      1410          LD     BC,FREE
0053 ED60        1420          LDIR
0055 36FF        1430          LD     (HL),RAMMRK;MARK TOP OF RAM
0057 010D28      1440 ;
0057 010D28      1450          LD     BC,UBUF   ;SET UP FOR UART
005A 09          1460          EXX
005B 210D28      1470          LD     HL,UBUF   ;SET UP FOR MAIN
005E 220328      1480          LD     (LNSTRT),HL
0061 1806        1490          JR     MAIN

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```

1520 ;          NMI RESTART JUMP
1530 ;          *****

0066          1550      ORG    $66
0066 C30028      1560          JP     JUMP

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```

1610 ;          MAIN LOOP
1620 ;          *****

0069 D0CB0056    1640 MAIN  BIT    POLL,(IX+0);GET POLL STATUS
006D F5          1650          PUSH   AF      ;SAVE IT
006E D0CB0096    1660          RES    POLL,(IX+0);DISABBLE POLLING
0072 D830        1670          IN     A,(PAD)
0074 CB67        1680          BIT    ONLINE,A   ;ONLINE ?
0076 2807        1690          JR     Z,STAT1   ;YES - GO FOR CHECKS
0078 CB07        1700          RES    BUSY,A     ;NO - FLAG AND SKIP CHECK

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007A D330      1710      OUT (PAD),A
007C F1        1720      POP AF
007D 1826      1730      JR MAINA
007F F5        1740 STAT1 PUSH AF
0080 21B203    1750      LD HL,FREE ;MAX POS WTCNT
0083 ED5B0A20  1760      LD DE,(WTCNT)
0087 AF        1770      XOR A
0088 ED52      1780      SBC HL,DE
008A B4        1790      OR H
008B 200A      1800      JR NZ,STAT2 ;BUFFER IS OK
008D 3E0A      1810      LD A,SPARE
008F B0        1820      CP L
0090 3805      1830      JR C,STAT2 ;BUFFER IS OK
0092 F1        1840      POP AF
0093 CBB7      1850      RES BUSY,A ;FLAG NEARLY FULL
0095 1803      1860      JR STAT3 ;SAVE IT
0097 F1        1870 STAT2 POP AF
0098 CBF7      1880      SET BUSY,A ;FLAG BUFR OK
009A D330      1890 STAT3 OUT (PAD),A ;OUTPUT FLAGS
009C F1        1900      POP AF
009D 2002      1910      JR NZ,STAT4 ;POLL WAS ENABLED
009F DB18      1920      IN A,(UDAT) ;CLEAR UART FLAGS
00A1 DDCB00D6  1930 STAT4 SET POLL,(IX+0)
                1940 ;
00A5 CDD002    1950 MAINA CALL LINFED
                1960 ;
00A8 2A0328    1970 MAINL LD HL,(LNSTRT);GET START ADDR
00AB 110000    1980      LD DE,0 ;ZERO COUNTERS
00AE 7E        1990 MAIN1 LD A,(HL) ;CHECKIN UBUF
00AF FEFE      2000      CP EMPTY
00B1 28B6      2010      JR Z,MAIN ;NO CHARACTER
00B3 1C        2020 MAIN2 INC E ;CHAR COUNT
00B4 FE60      2030      CP #60 ;CR or LF ?
00B6 3012      2040      JR NC,CORRLF ;YES - SERVICE IT
00B8 B7        2050      OR A ;IS IT A SPACE
00B9 2801      2060      JR Z,MAIN2A ;YES - SKIP
00BB 14        2070      INC D ;NO - INC 'NON SPACE'
00BC CD3303    2080 MAIN2A CALL INCHL ;MOVE HL UP
00BF 7B        2090      LD A,E ;COUNT > 80 ?
00C0 FE51      2100      CP 81
00C2 38EA      2110      JR C,MAIN1 ;NO - LOOK NEXT CHAR
00C4 CD3F03    2120      CALL DECHL ;YES - MOVE HL BACK
00C7 10        2130 MAIN3 DEC E ;ADJUST COUNT
00C8 1827      2140      JR PRINT ;GO PRINT LINE
00CA F5        2150 CORRLF PUSH AF ;SAVE CHAR
00CB 7B        2160      LD A,E
00CC FE01      2170      CP 1 ;1 CHAR ?
00CE 2803      2180      JR Z,CRLF1 ;YES - SERVICE IT NOW
00D0 F1        2190      POP AF ;NO - PRINT LINE
00D1 18F4      2200      JR MAIN3
00D3 36FE      2210 CRLF1 LD (HL),EMPTY ;MARK AS EMPTY
00D5 CD6303    2220      CALL DECWCT
00D8 110000    2230      LD DE,0 ;RESET COUNTERS
00DB CD3303    2240      CALL INCHL ;MOVE HL UP
00DE 220328    2250      LD (LNSTRT),HL ;START OF NEXTLINE
00E1 F1        2260      POP AF ;GET BACK CHAR
00E2 FE61      2270      CP UCR ;CR ?
00E4 2006      2280      JR NZ,CRLF2 ;NO - MUST BE LF
00E6 DB30      2290      IN A,(PAD)
00E8 CB47      2300      BIT AUTOLF,A ;AUTO LF ?
00EA 20C2      2310      JR NZ,MAIN1 ;IGNORE IT
00EC CDFC02    2320 CRLF2 CALL FEED ;DO LINE FEED
00EF 18BD      2330      JR MAIN1 ;LOOK AT NEXT CHAR

                2360 ; PRINT LINE
                2370 ; *****

00F1 ED530728  2390 PRINT LD (COUNTS),DE;SAVE COUNTS
00F5 4B        2400      LD C,E ;CHAR CNT TO C
00F6 CD3F03    2410      CALL DECHL ;FOR R TO L LNIE
00F9 DDCB0086  2420      RES LTOR,(IX+0);CLEAR L TO R FLAG
00FD DB30      2430      IN A,(PAD) ;L TO R ?
00FF CB57      2440      BIT LHS,A
0101 2007      2450      JR NZ,PT1 ;NO - R TO L,SO SNIP
0103 DDCB00C6  2460      SET LTOR,(IX+0);YES - FLAG IT
0107 2A0328    2470      LD HL,(LNSTRT);L TO R LINE START
                2480 ;
010A CD8503    2490 PT1 CALL MOTON ;START MOTOR
010D CD2403    2500 PT1A CALL ENDTST ;WAIT TIL OFF
0110 38FB      2510      JR C,PT1A
                2520 ;
0112 E5        2530      PUSH HL
0113 210520    2540      LD HL,NCOUNT ;WAIT 1 NMI
0116 3601      2550      LD (HL),1
0118 AF        2560      XOR A
0119 11F701    2570      LD DE,CNMI ;CHANGE $NMI
011C ED530120  2580      LD ($NMI),DE
0120 BE        2590 PT1B CP (HL) ;WAIT FOR COUNT
0121 20FD      2600      JR NZ,PT1B
                2610 ;

```

```

0123 DDCB0040 2620 BIT LTOR,(IX+0)
0127 2013 2630 JR NZ,PT2 ;SKIP IF L TO R
0129 3015 2640 LD (HL),5+10 ;DO I.C.C
012B BE 2650 PT1C CP (HL)
012C 20FD 2660 JR NZ PT1C
;
012E 3E50 2670 LD A,80 ;CALC SPACES TO WAIT
0130 91 2680 SUB C
0131 2809 2690 JR Z,PT2
0133 47 2700 LD B,A
0134 3013 2710 LD (HL),19 ;CHAR + ICG =NMIs
0136 AF 2720 XOR A
0137 BE 2730 PT1E CP (HL)
0138 20FD 2740 JR NZ,PT1E
013A 10FB 2750 DJNZ PT1D
;
013C E1 2760 POP HL
013D 3A0728 2770 LD A,(COUNTS)
0140 4F 2780 LD C,A
0141 110202 2790 LD DE,ONNMI ;ALTER $NMI TO PRIN
0144 ED530128 2800 LD ($NMI),DE
;
0148 7E 2810 LD A,(HL) ;GET CHAR
0149 5F 2820 LD E,A ;MULTIPLY BY 8
014A 1000 2830 LD D,0
014C 0603 2840 LD B,3 ;SHIFT DE LEFT * 3
014E CB23 2850 PT2A SLA E
0150 CB12 2860 RL D
0152 10FA 2870 DJNZ PT2A
0154 E5 2880 PUSH HL
0155 216005 2890 LD HL,DOTS
0158 19 2900 ADD HL,DE
0159 1600 2910 LD D,0 ;SUBTRACT ONCE FOR *7
015B 5F 2920 LD E,A
015C B7 2930 OR A
015D ED52 2940 SBC HL,DE
015F EB 2950 EX DE,HL ;DOT ADDR NOW IN DE
0160 E1 2960 POP HL
;
0161 DDCB0040 3000 BIT LTOR,(IX+0)
0165 200B 3010 JR NZ,PT2L ;SKIP FOR L TO R
0167 CD3F03 3020 CALL DECHL
016A 13 3030 INC DE ;ADJUST DOTS
016B 13 3040 INC DE
016C 13 3050 INC DE
016D 13 3060 INC DE
016E 13 3070 INC DE
016F 13 3080 INC DE
0170 1003 3090 JR PT3 ;SKIP
0172 CD3303 3100 CALL INCHL ;FOR L TO R
0175 0607 3110 PT3 LD B,7 ;DOTS/CHAR
;
0177 1A 3120 PT4 LD A,(DE) ;DOTS TO HEDBUF
0178 320928 3130 LD (HEDBUF),A
017B DDCB0040 3140 BIT LTOR,(IX+0)
017F 2003 3150 JR NZ,PT4L ;SKIP IF L TO R
0181 1B 3160 DEC DE
0182 1001 3170 JR PT5
0184 13 3180 INC DE
0185 3A0928 3190 PT5 LD A,(HEDBUF) ;WAIT FOR NMI
0188 17 3200 RLA
0189 30FA 3210 JR NC,PT5
018B 10EA 3220 DJNZ PT4
018D DDCB004E 3230 PT5A BIT NM,(IX+0) ;WAIT TILLNMI OFF
0191 20FA 3240 JR NZ,PT5A
0193 11F701 3250 LD DE,CNMI
0196 ED530128 3260 LD ($NMI),DE ;COUNT ICG
019A E5 3270 PUSH HL
019B 210528 3280 LD HL,NCOUNT
019E 3605 3290 LD (HL),5
01A0 AF 3300 XOR A
01A1 BE 3310 PT5B CP (HL)
01A2 20FD 3320 JR NZ,PT5B
01A4 E1 3330 POP HL
01A5 0D 3340 DEC C ;ALL CHARS DONE
01A6 2099 3350 JR NZ,PT22
;
01A8 112B02 3360 LD DE,IGNNMI ;NMI TO BE IGNORED
01AB ED530128 3370 LD ($NMI),DE
01AF CD2403 3380 PT6 CALL ENDTST
01B2 30FB 3390 JR NC,PT6 ;WAIT TIL HEAD AT END
01B4 CDC202 3400 CALL DEBONC
01B7 3A0028 3410 LD A,(COUNTS+1);ACTUAL PRINTED CHARS
01BA FE29 3420 CP CHLINE+1
01BC 3010 3430 JR C,PT7 ;COUNT (= CHLINE IS OK
01BE CD2403 3440 PT6A CALL ENDTST ;DO EXTRA RUN
01C1 30FB 3450 JR C,PT6A
01C3 CDC202 3460 CALL DEBONC ;SIMPLE DELAY
01C6 CD2403 3470 PT6B CALL ENDTST
01C9 30FB 3480 JR NC,PT6B
01CB CDC202 3490 CALL DEBONC
01CE CD4803 3500 PT7 CALL MOTOFF ;MOTOR OFF
;
3540 ;

```

```

01D1 3A0720 3550 LD A,(COUNTS) ;CLEAR LINE IN UBUF
01D4 47 3560 LD B,A
01D5 5F 3570 LD E,A
01D6 2A0520 3580 LD HL,(LNSTRT)
01D9 36FE 3590 PT8 LD (HL),EMPTY
01DB CD3303 3600 CALL INCHL
01DE 10F9 3610 DJNZ PT8
01E0 CD6303 3620 CALL DECWCT ;UPDATE WTCNT
01E3 220520 3630 LD (LNSTRT),HL
3640 ;
01E6 7E 3650 LD A,(HL) ;HL=START OF NEXT LINE
01E7 FE61 3660 CP UCR ;IF NEXT CHAR IS NOT
01E9 CA6900 3670 JP Z,MAIN ; CR OR LF THEN DO
01EC FE60 3680 CP ULF
01EE CA6900 3690 JP Z,MAIN
01F1 CD6C02 3700 CALL FEED ; LINEFEED
01F4 C36900 3710 JP MAIN

```

```

3750 ; NMI JUMP TARGETS
3760 ; *****

```

```

3790 ;DEC (NCOUNT)

```

```

01F7 F5 3810 CNMI PUSH AF
01F8 3A0520 3820 LD A,(NCOUNT)
01FB 3D 3830 DEC A
01FC 320520 3840 LD (NCOUNT),A
01FF F1 3850 POP AF
0200 1029 3860 JR IGNNMI

```

```

3890 ;NMI TARGET FOR HEAD ON

```

```

0202 F5 3910 ONNMI PUSH AF
0203 E5 3920 PUSH HL
0204 211C02 3930 LD HL,OFFNMI ;SWAP $NMI
0207 DDCB00CE 3940 SET NM,(IX+0)
0208 3A0920 3950 LD A,(HEDBUF)
020E D331 3960 OUT (PBD),A ;OUTPUT HEAD DATA
0210 CBFF 3970 SET HMOTOR,A ;FLAG DONE, FOR HOST
0212 320920 3980 LD (HEDBUF),A
0215 220120 3990 NMEXT LD ($NMI),HL
0218 E1 4000 POP HL
0219 F1 4010 POP AF
021A 100F 4020 JR IGNNMI

```

```

4050 ;NMI TARGET FOR HEAD OFF

```

```

021C F5 4070 OFFNMI PUSH AF
021D E5 4080 PUSH HL
021E AF 4090 XOR A ;DGT5 OFF
021F D331 4100 OUT (PBD),A ;OUTPUT IT
0221 210202 4110 LD HL,ONNMI ;SWAP $NMI
0224 DDCB000E 4120 RES NM,(IX+0)
0228 10EB 4130 JR NMEXT

```

```

4160 ;COUNT NMIs INTO 'HL'
4170 ; IGNORE NMI
4180 ; AND UART POLLING + ROUTINE

```

```

022A 23 4200 CNTNMI INC HL
022B 00 4210 IGNNMI EX AF,AF'
022C DDCB0056 4220 BIT POLL,(IX+0);DO WE POLL?
0230 2064 4230 JR Z,ENDPOL ;NO - SKIP
0232 DB20 4240 IN A,(USTAT) ;YES - GET UART STATUS
0234 17 4250 RLA
0235 305F 4260 JR C,ENDPOL ;NO CHARACTER READY
0237 D9 4270 EXX
0238 2F 4280 CPL
0239 E61C 4290 AND UFMASK ;TEST FLAGS
023B 2009 4300 JR Z,UART2 ;'Z' = DATA OK
023D DB10 4310 IN A,(UDAT) ;READ TO CLEAR FLAGS
023F CDD402 4320 CALL LEDON ;RESET LED ON
0242 3E7F 4330 LD A,#7F ;RUBBISH CHAR
0244 1004 4340 JR UART3 ;PROCESS NORMALLY
0246 DB10 4350 UART2 IN A,(UDAT) ;GET DATA BYTE
0248 E67F 4360 AND #7F ;REMOVE PARITY BIT
024A FE00 4370 UART3 CP CR ;CR ?
024C 2002 4380 JR NZ,UART3A ;NO-SKIP
024E 3EB1 4390 LD A,UCR+#20 ;YES-CHANGE CODE
0250 FE0A 4400 UART3A CP LF ;LF ?
0252 2002 4410 JR NZ,UART3B ;NO-SKIP
0254 3E00 4420 LD A,ULF+#20 ;YES-CHANGE CODE
0256 FE00 4430 UART3B CP BS ;BS ?
0258 203F 4440 JR Z,UBKSP ;YES - PROCESS IT

```

```

025A D620      4450      SUB    #20      ;ADJUST CODE
025C 3837      4460      JR     C,UEXIT    ;IGNORE CONTROL CODES
025E 02        4470      LD     (BC),A     ;SAVE CHAR
025F 21B203    4480      LD     HL,FREE    ;CHECK MAX NO OF CHARS
0262 ED5B0A28  4490      LD     DE,(WTCNT)  ; WAITING TO BE
0266 13        4500      INC     DE        ; PRINTED
0267 AF        4510      XGR     A
0268 ED52      4520      SBC     HL,DE
026A 2006      4530      JR     NZ,UART6    ;'Z'=NO SPACE LEFT
026C 1B        4540      DEC     DE        ;ADJUST WTCNT
026D CD0402    4550      CALL    LEDON     ;SHOW BUFFER OV
0270 181F      4560      JR     UART7      ;SKIP 'WARNING' CHEK
                                4570 ;NOW SEE IF (SPARE IS FREE
0272 B4        4580      OR     H          ;MSB=0 ?
0273 200D      4590      JR     NZ,UART8    ;IF NOT SKIP REST
0275 3E0A      4600      LD     A,SPARE    ;CHECK LSB ( SPARE
0277 BD        4610      CP     L
0278 3806      4620      JR     C,UART8    ;'C'=OK
027A DB3D      4630      IN     A,(PAD)    ;T.ON 'BUFFER FULL'
027C C8B7      4640      RES     BUSY,A
027E D33D      4650      OUT    (PAD),A
0280 1806      4660      JR     UART9      ;SKIP
0282 DB3D      4670      IN     A,(PAD)    ;T.OFF 'BUFF FULL'
0284 C8F7      4680      SET     BUSY,A
0286 D33D      4690      OUT    (PAD),A
                                4700 ;NOW ADJUST AND CHECK 'BC'
0288 03        4710      UART9 INC     BC      ;NEXT RAM ADDR
0289 0A        4720      LD     A,(BC)    ;GET BYTE
028A FEFF      4730      CP     RAMMRK    ;TOP OF UBUF ?
028C 2003      4740      JR     NZ,UART7    ;NO-SKIP
028E 010D28    4750      LD     BC,UBUF    ;YES-RESET 'BC'
0291 ED530A28  4760      LD     (WTCNT),DE ;SAVE 'WAIT COUNT'
0295 D9        4770      UEXIT  EXX
0296 08        4780      ENDPOL  EX  AF,AF'
0297 ED45      4790      RETN
                                4800 ;
0299 ED5B0A28  4810      UBXSP  LD     DE,(WTCNT) ;No. WAITING
029D 7A        4820      LD     A,D      ;IF DE=0 IGNORE BS
029E B3        4830      OR     E
029F 28F4      4840      JR     Z,UEXIT
02A1 60        4850      LD     H,B      ;GET BC INTO HL
02A2 69        4860      LD     L,C
02A3 CD3F03    4870      CALL    DECHL    ;MOVE DOWN BUFFER
02A6 7E        4880      LD     A,(HL)    ;GET CONTENTS
02A7 FE60      4890      CP     #60     ;CR or LF ?
02A9 30EA      4900      JR     NC,UEXIT    ;YES - IGNORE BS
02AB 36FE      4910      LD     (HL),EMPTY ;NO - RUBOUT
02AD 44        4920      LD     B,H      ;PUT NEW POINTER VALUE
02AE 4D        4930      LD     C,L      ; INTO BC
02AF 1B        4940      DEC     DE      ;DEC No. WAITING
02B0 ED530A28  4950      LD     (WTCNT),DE ;SAVE IT
02B4 180F      4960      JR     UEXIT

```

```

5010 ;          SUBROUTINES
5020 ;          *****

```

```

5050 ;DELAY FOR 2.5 MS @ 1.8432 MHz

```

```

02B6 F5        5070      DELAY  PUSH  AF
02B7 3E4F      5080      LD     A,79      ;LOOP COUNT
02B9 F5        5090      DELAY1 PUSH  AF
02BA F1        5100      POP   AF
02BB F5        5110      PUSH  AF
02BC F1        5120      POP   AF
02BD 3D        5130      DEC     A
02BE 20F9      5140      JR     NZ,DELAY1
02C0 F1        5150      POP   AF
02C1 C9        5160      RET

```

```

5190 ;GET DEBOUNCE DATA FROM PORT 'A'

```

```

02C2 C5        5210      DEBONC PUSH  BC
02C3 DB3D      5220      DER1  IN     A,(PAD) ;GET INPUT
02C5 4F        5230      LD     C,A      ;SAVE IN C
02C6 0603      5240      LD     B,3      ;DELAY FOR 7.5 MS
02C8 CDB602    5250      DER2  CALL    DELAY
02CB 10FB      5260      DJNZ    DER2
02CD DB3D      5270      IN     A,(PAD)    ;GET INPUT AGAIN
02CF B9        5280      CP     C
02D0 20F1      5290      JR     NZ,DER1    ;ANY CHANGE ?
02D2 C1        5300      POP   BC        ;YES - GO AGAIN
02D3 C9        5310      RET          ;NO - FINISH

```

5340 ;SWITCH ON LED

```

02D4 F5      5360 LEDON  PUSH AF
02D5 D830    5370      IN  A,(PAD)  ;GET PRESENT STAT
02D7 C8BF    5380      RES  RSLED,A  ;CHANGE LED BIT
02D9 D330    5390      OUT  (PAD),A  ;OUTPUT IT
02DB F1      5400      POP  AF       ;RESTORE
02DC C9      5410      RET

```

5440 ;LOOK FOR LF SWITCH

```

02D0 CDC202  5460 LINFED CALL DEBONC  ;GET SW INFO
02E0 C85F    5470      BIT  LFSW,A
02E2 C0      5480      RET  NZ
02E3 CDFC02  5490      CALL FEED  ;DO LINE FEED
02E6 0600    5500      LD   B,0      ;DELAY 640 MS
02E8 CD8002  5510 LFED2  CALL DELAY
02EB D830    5520      IN  A,(PAD)  ;RET IF SW RELEASED
02ED C85F    5530      BIT  LFSW,A
02EF C0      5540      RET  NZ
02F0 10F6    5550      DJNZ LFED2  ;FINISH DELAY
02F2 D830    5560 LFED1  IN  A,(PAD)  ;STILL PRESSED
02F4 C85F    5570      BIT  LFSW,A  ;?
02F6 C0      5580      RET  NZ      ;RET IF NOT
02F7 CDFC02  5590      CALL FEED  ;DO FEED
02FA 10F6    5600      JR   LFED1  ;MORE ?

```

5630 ; DO LINE FEED

```

02FC C5      5650 FEED  PUSH BC
02FD 0630    5660      LD   B,STEPS+STEPS;(STEPS / LINE)*2
02FF DDCB0056 5670 NXTSTP BIT  POLL,(IX+0);SAVE POLL BIT
0303 F5      5680      PUSH AF  ;SAVE IT
0304 DDCB0096 5690      RES  POLL,(IX+0);DISSABLE POLL
0308 D830    5700      IN  A,(PAD)  ;FLIP LFSTEP BIT
030A CB6F    5710      BIT  LFSTEP,A
030C 2004    5720      JR   Z,STPON
030E CBAF    5730      RES  LFSTEP,A
0310 1002    5740      JR   STPEND
0312 C8EF    5750 STPON  SET  LFSTEP,A
0314 D330    5760 STPEND OUT  (PAD),A
0316 F1      5770      POP  AF
0317 2004    5780      JR   Z,STPDON  ;POLL WAS DISSABLED
0319 DDCB0006 5790      SET  POLL,(IX+0)
031D CD8002  5800 STPDON CALL DELAY  ;2.5 MS
0320 1000    5810      DJNZ NXTSTP
0322 C1      5820      POP  BC
0323 C9      5830      RET

```

5860 ;RETURN CARRY SET IF HEAD IS AT
5870 ; EITHER END, ELSE CARRY CLEAR

```

0324 F5      5890 ENDTST PUSH AF
0325 D830    5900      IN  A,(PAD)  ;GET SW DATA
0327 F6F9    5910      OR   EF9      ;MASK AND FLIP
0329 2F      5920      CPL
032A B7      5930      JR   A      ;'Z'=ON PRINT STROKE
032B 2003    5940      JR   NZ,ATEND ;'NZ'=AT 1 END
032D F1      5950      POP  AF
032E B7      5960      OR   A
032F C9      5970      RET
0330 F1      5980 ATEND  POP  AF
0331 37      5990      SCF  ;SET FLAG
0332 C9      6000      RET

```

6030 ;INC HL UP UBUF

```

0333 F5      6050 INCHL  PUSH AF
0334 3EFF    6060      LD   A,RAMMRK
0336 23      6070      INC  HL
0337 BE      6080      CP   (HL)    ;TOP OF UBUF ?
0338 2003    6090      JR   NZ,INCHLX ;NO - EXIT
033A 21002B  6100      LD   HL,UBUF  ;RESET HL
033D F1      6110 INCHLX POP  AF
033E C9      6120      RET

```

6150 ;DEC HL DOWN UBUF

```

033F F5      6170 DECHL  PUSH AF
0340 3EFF    6180      LD   A,RAMMRK
0342 2B      6190      DEC  HL
0343 BE      6200      CP   (HL)    ;BOT OF UBUF ?
0344 2003    6210      JR   NZ,DECHLX ;NO - EXIT
0346 210E2B  6220      LD   HL,UBUFT  ;YES - RESET HL
0349 F1      6230 DECHLX POP  AF
034A C9      6240      RET

```

6270 ;SWITCH OFF MOTOR - \$NMI = IGNORE

034B E5	6290 MOTOFF	PUSH HL
034C C5	6300	PUSH BC
034D F5	6310	PUSH AF
034E 212B02	6320	LD HL,IGNNMI
0351 220128	6330	LD (\$NMI),HL
0354 061E	6340	LD B,30
0356 CDB602	6350 MOFF1	CALL DELAY
0359 10FB	6360	DJNZ MOFF1
035B 3E00	6370	LD A,\$80
035D D331	6380	OUT (FBD),A
035F F1	6390	POP AF
0360 C1	6400	POP BC
0361 E1	6410	POP HL
0362 C9	6420	RET

6450 ;WTCNT = WTCNT - E
 6460 ; * POLLING MUST BE DISSABLED
 6470 ; THEN RESTORED AS BEFORE

0363 F5	6490 DECWCT	PUSH AF
0364 D5	6500	PUSH DE
0365 E5	6510	PUSH HL
0366 DDCB0056	6520	BIT POLL,(IX+0);GET POLL BIT
036A F5	6530	PUSH AF ; AND SAVE IT
036B DDCB0096	6540	RES POLL,(IX+0)
036F 1600	6550	LD D,0
0371 B7	6560	OR A
0372 2A0A28	6570	LD HL,(WTCNT)
0375 E152	6580	SBC HL,DE
0377 220A28	6590	LD (WTCNT),HL
037A F1	6600	POP AF
037B 2804	6610	JR Z,DECWEX ;POLL WAS DISSABLED
037D DDCB00D6	6620	SET POLL,(IX+0)
0381 E1	6630 DECWEX	POP HL
0382 D1	6640	POP DE
0383 F1	6650	POP AF
0384 C9	6660	RET

6690 ;TURN MOTOR ON

0385 C5	6710 MOTON	PUSH BC
0386 F5	6720	PUSH AF
0387 0604	6730	LD B,4
0389 AF	6740 MOTON1	XOR A
038A D331	6750	OUT (FBD),A
038C CDB602	6760	CALL DELAY
038F CDB602	6770	CALL DELAY
0392 3E00	6780	LD A,\$80
0394 D331	6790	OUT (FBD),A
0396 CDB602	6800	CALL DELAY
0399 CDB602	6810	CALL DELAY
039C 10EB	6820	DJNZ MOTON1
039E AF	6830	XOR A
039F D331	6840	OUT (FBD),A
03A1 F1	6850	POP AF
03A2 C1	6860	POP BC
03A3 C9	6870	RET

Z80 1.2 Z80 Assembler - Symbol Table

2801H	0850	%NMI	0330H	5980	ATEND
0000H	0400	AUTOLF	0008H	0580	BS
0006H	0460	BUSY	0028H	0690	CHLINE
01F7H	3810	CNMI	022AH	4200	CNTNMI
2807H	0890	COUNTS	000DH	0570	CR
00D3H	2210	CRLF1	00ECH	2320	CRLF2
00CAH	2150	CRORLF	02C3H	5220	DEB1
02C8H	5250	DEB2	02C2H	5210	DEBONC
033FH	6170	DECHL	0349H	6230	DECHLX
0363H	6490	DECWCT	0381H	6630	DECWEX
02B6H	5070	DELAY	02B9H	5090	DELAY1
0560H	6940	DOTS	00FEH	0620	EMPTY
0800H	7940	END	0296H	4780	ENDFUL
0324H	5890	ENDTST	02FCH	5650	FEED
2806H	0880	FLAG	03B2H	0960	FREE
2809H	0910	HEDBUF	0007H	0500	HMOTOR
022BH	4210	IGNNMI	0333H	6050	INCHL
033DH	6110	INCHLX	2809H	0900	INIT
280CH	0930	INITE	0005H	0600	INTCHR
2800H	0840	JUMP	02D4H	5360	LEDON
000AH	0560	LF	02F2H	5560	LFED1
02E8H	5510	LFED2	0005H	0450	LFSTEP
0003H	0430	LFSW	0002H	0420	LHS
02DDH	5460	LINFED	2803H	0860	LNSTRT
0039H	1290	LOFF	0000H	0750	LTOR
0067H	1640	MAIN	00AEH	1990	MAIN1
00B3H	2020	MAIN2	00BCH	2080	MAIN2A
00C7H	2130	MAIN3	00A5H	1950	MAINA
00ABH	1970	MAINL	001FH	0480	MASK
0356H	6350	MOFF1	034BH	6290	MOTOFF
0385H	6710	MOTON	0389H	6740	MOTON1
2805H	0870	NCOUNT	0001H	0760	NM
0215H	3990	NMIEXT	05F0H	0670	NMITOT
02FFH	5670	NXTSTP	021CH	4070	OFFNMI
0004H	0440	ONLINE	0202H	3910	ONNMI
0032H	0190	PAC	0030H	0180	PAD
0033H	0210	PBC	0031H	0200	PBD
0002H	0770	POLL	00F1H	2390	PRINT
010AH	2490	PT1	010DH	2500	PT1A
0120H	2590	PT1B	012BH	2650	PT1C
0134H	2720	PT1D	0137H	2740	PT1E
013CH	2780	PT2	0141H	2810	PT22
014EH	2880	PT2A	0172H	3110	PT2L
0175H	3120	PT3	0177H	3140	PT4
0184H	3200	PT4L	0185H	3210	PT5
018DH	3250	PT5A	01A1H	3330	PT5B
01AFH	3410	PT6	018EH	3470	PT6A
01C6H	3500	PT6B	01CEH	3530	PT7
01D9H	3590	PT8	2800H	0300	RAM
0400H	0310	RAMLEN	00FFH	0610	RAMMRK
0000H	1050	RESET	0001H	0410	RHS
0000H	0340	ROM	0007H	0470	RSLED
0043H	1340	SET1	002FH	1250	SETHED
000AH	0630	SPARE	2C00H	0320	STACK
0040H	0640	STACKL	007FH	1740	STAT1
0097H	1870	STAT2	009AH	1890	STAT3
00A1H	1930	STAT4	0018H	0650	STEPS
031DH	5800	STPDON	0314H	5760	STFEND
0312H	5750	STPON	0246H	4350	UART2
024AH	4370	UART3	0250H	4400	UART3A
0256H	4430	UART3B	025EH	4470	UART4
0272H	4580	UART6	0271H	4760	UART7
0282H	4670	UART8	0280H	4710	UART9
0299H	4810	UBKSP	280CH	0940	UBOT
280DH	0950	UBUF	28BEH	0970	UBUFT
0061H	0600	UCR	0018H	0230	UDAT
0295H	4770	UEXIT	001CH	0660	UFMASK
0060H	0590	ULF	0028H	0240	USTAT
280AH	0920	WTCNT			

Appendix 7.3

ASCII character set

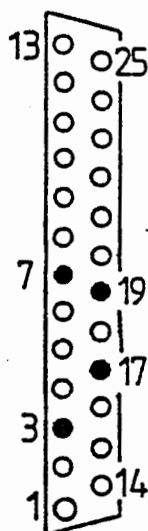
Note the substitution for the hash-mark of a £ sign (character 35).
The character set is otherwise to ASCII specification.

LIST		77	M
		78	N
10 FOR A=32 TO 127		79	O
20 PRINT A , CHR\$(A)		80	P
30 NEXT		81	Q
OK		82	R
RUN		83	S
32		84	T
33	!	85	U
34	"	86	V
35	£	87	W
36	\$	88	X
37	%	89	Y
38	&	90	Z
39	'	91	[
40	(92	\
41)	93]
42	*	94	↑
43	+	95	-
44	,	96	`
45	-	97	a
46	.	98	b
47	/	99	c
48	0	100	d
49	1	101	e
50	2	102	f
51	3	103	g
52	4	104	h
53	5	105	i
54	6	106	j
55	7	107	k
56	8	108	l
57	9	109	m
58	:	110	n
59	;	111	o
60	<	112	p
61	=	113	q
62	>	114	r
63	?	115	s
64	@	116	t
65	A	117	u
66	B	118	v
67	C	119	w
68	D	120	x
69	E	121	y
70	F	122	z
71	G	123	{
72	H	124	
73	I	125	}
74	J	126	~
75	K	127	
76	L	OK	

Appendix 7.4

Connection to NASCOM-1

1. Connect the printer clock signal from pin 17 of the DB25 connector to the older post P1, marked EXT SERIAL CLOCK.
2. Connect the BUSY signal from pin 19 of the DB25 connector to pin 8 of the keyboard socket SK1.
3. Connect RS232 ground from pin 7 of the DB25 connector to pin 8 of the serial data socket SK2, not to power supply ground.
4. Connect the RS232 input from pin 14 of SK2 to pin 3 of the DB25 connector.



Appendix 7.5

Connection to NASCOM-2

1. Set LSW2/2 and /3 UP and the remaining switches as is appropriate. The NASCOM-2 will now run at the baud rate selected on the printer. Operation at over 300 baud will require the use of handshaking logic; to set this up connect pin 8 of PL2 to TP3 on the NASCOM-2 board.

2. Wire the serial interface cable supplied with NASCOM-2 as follows:

core 4: yellow	DB25P pin 17
core 8: grey	" " 19
core 6: blue	" " 3
core 11: brown	" " 7

Note that yellow, blue and brown wires appear elsewhere in the ribbon; cores should be counted if there is any doubt in identification.

3. If the system appears to be unnaturally sensitive to noise a 0.1uF capacitor may be connected between TP3 and ground.

4. Note that the BUSY signal is active low.

Appendix 7.6

RS232 connections and signal levels

DB25 connector pin	connection	signal level
7 (RS232 ground)	to system ground OR RS232 ground if provided; NOT to -5v or -12v rails present in certain systems	none
3 (RS232 input)	to RS232 output of host system, normally pin 2 of the output connector	+12v; TTL levels are satisfactory
17 (clock output)	to 6402 type UART accepting external clocking at 16x baud rate; this output is pulled up to 5v internally	TTL
19 (<u>BUFFER FULL</u>)	to RS232 <u>BUSY</u> input	TTL active low

Print

The character is created by a seven needle print head. Characters are created by a 7 x 7 Dot matrix. The printer works bi-directionally. The image is printed with an endless loop ribbon cartridge.

Size

The IMP is much smaller than we have come to expect. Depth 23.5 cm (9¼ inches) Height 9.0 cm (3½ inches) Length 40.5 cm (16 inches).

Paper

There are many paper possibilities. Pressure feed and tractor feed are both supported. Under the pressure feed option, paper up to 8½ inches can be used, this includes A4. Using tractor feed the paper size can be up to 9½ inches including the punch holes on each side. The tractor guides are movable and the paper size can range from 3 to 9½ inches.

Character Set

The IMP has 95 ASCII characters (the 96th being the £ sign which replaces hash). These are:-


```

H I J K L M N O P Q R S T U V W X Y Z [ \ ] ^ _ ` a b c d e f g h i j k l m n o
p q r s t u v w x y z { | } ~ ¡ ¢ £ ¤ ¥ ¦ § ¨ © ª « ¬ ® ¯ ° ± ² ³ ´ µ ¶ · ¸ ¹ º »
¼ ½ ¾ ¿ À Á Â Ã Ä Å Æ Ç È É Ê Ë Ì Í Î Ï Ñ Ò Ó Ô Õ Ö × Ø Ù Ú Û Ü Ý Þ ß à á â
ã ä å æ ç è é ê ë ì í î ï ñ ò ó ô õ ö ÷ ø ù ú û ü ý þ ÿ

```

This is reduced to 2/3rds actual size.

Operation

- * The printer is controlled by a Z80 CPU.
- * The Character set and software is held in a 2K ROM. This ROM is pin compatible with a 2716 EPROM. This offers the possibility of individual character sets.
- * Listing and circuit diagrams will be supplied with each printer.
- * Data transmission errors automatically print a  and the Reset LED will light.
- * Normal NASCOM operation under T4 or NAS SYS will produce a line feed after a carriage return. However a link option is available for use with other systems without this facility.
- * There is a maximum of 80 Characters per line.

Flexible Input/Output

The IMP can be set with any of the standard baud rates between 110 and 9600.

A TTL output is available at 16 times the selected baud rate for operation of an external UART of the 6402 type. This allows N1 and N2 users to synchronise their UART output to the printer clock allowing greater flexibility. In fact, as this facility is available at all times, a Nascom user could alter the baud rate of his CPU board to that set in the printer and use this rate to operate other peripherals.

Buffer

A "busy" signal will be active when only 10 characters are needed to fill the 945 character buffer. The signal will be maintained until more buffer space is available.

Interfacing

The IMP is controlled via a V24/RS232 serial interface which is TTL level compatible.

It can operate at the following baud rates, which are selected by changing a link on a DIL header.

110, 150, 200, 300, 600, 1200, 1800, 2400, 3600, 4800, 7200, 9600.

The IMP as supplied will be set at 300 Baud.

The following options can be selected by making the appropriate connections on a DIL header plug:

- a) Seven or eight bits, the IMP will ignore the eighth bit if eight bit input is selected.
- b) One or two stop bits.
- c) Parity on/off.
- d) Even or odd parity (parity must be on).
- e) LF after CR, will automatically generate a LF in addition to a CR on receipt of a CR.

The IMP will be delivered set up so as to be both N1 and N2 compatible.

The IMP is mounted on a cold formed aluminium base with an ABS cover. A standard DB25 socket is mounted on the rear panel for connection to the Host system. The IMP has proved to be significantly quieter than previous printers of this type.

Appendix 7.8

Software interface for NAS-SYS I

ZEAF Z80 Assembler - Source Listing

```

0030 ; *****
0040 ; *
0050 ; * Program to run the IMP printer *
0060 ; * with full handshake, *
0070 ; * for NAS-SYS *
0080 ; *
0090 ; *****

```

```

0130 ; Execute the program at #C80. This
0140 ;sets up the $UOUT jump, so that whenever
0150 ;the "U" command is activated output will
0160 ;go to the printer, using the handshake
0170 ;facility.

```

```

0190 ; This program assumes that the BUSY
0200 ;line from the IMP is connected to BIT
0210 ;7 of the Keyboard input port (PORT 0).

```

```

-0C20      0250      ORG    #0C80
           0260 ;
           0270 ;
0C80 0C77   0280 $UOUT EQU    #0C77
0C80 006E   0290 XOUT  EQU    #6E
0C80 005B   0300 MRET  EQU    #5B
           0310 ;
           0320 ;
0C80 21880C 0330      LD    HL,OUTPUT      ;ADDR OF OUTPUT ROUTINE
0C83 22780C 0340      LD    ($UOUT+1),HL  ;CHANGE $UOUT
0C86 DF5B   0350      SCAL MRET            ;RETURN TO MONITOR
           0360 ;
           0370 ;
           0380 ;
0C88 F5     0390 OUTPUT PUSH AF           ;SAVE CHAR
0C89 DB00   0400 OUT1  IN  A,(0)          ;BUSY ?
0C8B E680   0410      AND    #80
0C8D 28FA   0420      JR    Z,OUT1        ;YES - WAIT TILL NOT BUSY
0C8F F1     0430      POP  AF             ;GET CHAR BACK
0C90 DF6E   0440      SCAL XOUT           ;OUTPUT CHAR
0C92 C9     0450      RET

```

ZEAF Z80 Assembler - Symbol Table

```

0C77H 0280 $UOUT      005BH 0300 MRET
0C89H 0400 OUT1      0C88H 0390 OUTPUT
006EH 0290 XOUT

```

ERRATA

document

IMP printer manual

issue 4

date

21:3:80

NM number

103-300

page 20: the diagram of the DB25S connector is shown laterally inverted; to illustrate the socket correctly the diagram should be viewed as its mirror image OR regarded as the aspect from the inside of the printer's case.

it is advisable to make the
above corrections to your copy
now and to keep this sheet.